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(54) METHOD OF EMBOSSING POLYURETHANE FOAM LAMINATED TO A CARPET

(71) We, IMPERIAL CHEMICAL INDUSTRIES LIMITED, Imperial Chemical House, Millbank, London SW1P 3JF, a British Company, do hereby declare the invention,

for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The present invention relates to embossed foam and in particular to a process and apparatus for embossing polyurethane foam laminated to a carpet as a backing.

Flexible foam is well known in the flooring trade particularly foam made from polyvinyl chloride and for example rubber latex. Such foam is used as an underlay and is frequently embossed. Foams from polyvinyl chloride can be embossed by heat embossing because the polymer is thermoplastic by heating the foam so that it is deformable and subsequently contacting heat softened foam with an embossing surface such as the surface of a roller. Alternatively the roller may be heated. In the case of a foam made from rubber latex, embossing is generally carried out by contacting the foam with a cold or non-heated embossing roller after gelling of the latex but before vulcanisation of the rubber.

More recently, flexible polyurethane foams have been used in the flooring industry, particularly as carpet backing. However embossing of the polyurethane foam can be difficult. Embossing of the polyurethane foam before crosslinking is generally used because embossing after crosslinking with cold rolls is not possible; but difficulties often arise because the foam is only susceptible to emb[illegible]ng for a relatively short period of tim[illegible] during the polyurethane foam forming reaction. This is because before said period and early in the reaction, the foam surface is tacky and the foam hence sticks to the embossing roll with attendent spoiling of the foam; after said period the reaction has proceeded through crosslinking to an extent where deformation using a cold embossing roll is no longer possible. In any case only a light emboss is available by these techniques.

If an embossed polyurethane foam is required, some thermoplasticity in the foam can be used after crosslinking provided that relatively high temperatures of 170°C to 220°C can be tolerated. However such high temperatures often lead to damage of the carpet pile or backing having regard to materials conventionally used in the carpet industry.

According to the present invention a process is provided for embossing crosslinked flexible polyurethane foam laminated to a carpet which comprises contacting the foam against at least half of the circumferential surface of an embossing roll heated at its surfact to a temperature of from 120°C to 150°C.

The roll is made from any material conventional in the art, suitably mild or stainless steel and has a diameter of preferably 200 mm to 5000 mm most preferably 200 mm to 2000 mm with diameter of about 1000 mm being most convenient. The smaller diameter, the lower the running speed, whilst the highest diameters are associated with very high running speeds and high equipment costs. The roll has an embossing surface as required and a width of up to 5·5 m. The roll is preferably driven rather than freely rotatable to reduce damage to the foam. The roll is heatable, conveniently by steam, and in the process of the invention a surface temperature of 120°C to 150°C is used, the upper temperature depending on the heat sensitivity of the carpet materials and the lower temperature on the heat deformation characteristics of the polyurethane foam. The surface of the roll may if desired be coated with material to reduce the tendency

of the foam to stick to the surface. Such materials include silicones and tetrafluoroethylene polymers (e.g. "Fluon", Trade Mark, Imperial Chemical Industries Limited, London).

In accordance with the present invention, the foam is maintained around at least half of the circumference of the embossing roll; hence the contact time and through-put is maximised for a given rotational speed. With a given roll, the faster the rotational speed, the greater the circumferential contact distance to give a required contact time. Accordingly, if a certain contact time is required to produce an emboss, the process of the present invention provides a method of increasing the linear output of embossed foam. This compensates for the carpet fabric damaging effect of high embossing temperature to enable an emboss to be achieved. A suitable range of contact time is between 3 seconds and 2 minutes, typically for a roll diameter of 500 mm.

The foam may be maintained against the surface of the embossing roll by tension in the carpet. An alternative method is to urge the foam against the embossing surface with a belt, preferably one continuous belt, which in effect travels around substantially the complete circumference of the embossing roll. Preferably the foam and the belt where used covers 75% to 90% of the circumference of the roll. However for larger widths uniform quality of a belt may present difficulties and hence for larger widths, a non-belt system is preferred.

The foam or belt where one is used to support the foam may be guided around the embossing roll by guide rolls, preferably four, of which two define the gap size and the depth of the initial and final nip through which the foam may pass; conveniently these two rolls are above the surface of the upper half of a horizontally mounted embossing roll and their distance from the roll may be varied. Other guide rolls, preferably two, are provided to maintain the nip and control tension in the foam or belt and hence pressure of the foam against the embossing roll. Accordingly, the depth of the emboss on the foam may be adjusted and controlled; this is particularly important where foam backing of carpets having pressure sensitive pile is to be embossed, e.g. velour type. Suitably the nip is the same as or slightly less than the combined thickness of the carpet and the foam. A nip of 12 to 16 mm is generally suitable.

The foam or belt and the embossing roll are preferably both driven at the same rotational speed, a convenient speed is a linear speed of 6 metres per minute, but speed will depend on for example the type of foam, the embossing roll temperature, the length of circumference covered by the foam or belt.

Conveniently the foam is generated from a liquid mixture of the foam-forming ingredients which are allowed to react to form a layer of foam. Such manufacture of flexible polyurethane foams is well known and has already been described in the literature. The principal ingredients of such mixtures are an organic polyisocyanate, a polyether or polyester polyol having a hydroxyl number of from 30 to 100 preferably 30 to 70, and water as blowing agent. Additionally the reaction mixture usually contains one or more catalysts and surface active agents and optionally other adjuvants such as fillers, flameproofing agents and other blowing agents such as trichlorofluoromethane. Suitable polyisocyanates include tolylene diisocyanate and diphenylmethane diisocyanate either of which may be in substantially pure or crude form and mixtures of such isocyanates. Suitable polyols include polyether and ethylene oxides. Catalysts which may be used include organic tin compounds and tertiary amines.

The invention is illustrated with reference to the accompanying figure which is a perspective, diagrammic drawing of an apparatus operating the process according to the invention.

In the figure, a horizontally mounted embossing roll 1 has embossed surface 2 and a continuous belt 3 covering about 60% of the continuous circumference of roll 1. Belt 3 travels around four guide rolls 4, 5, 6, 7 of which rolls 4 and 5 define a feed nip 8 and a removal nip 9 for the material to be embossed. Rolls 6 and 7 are located so as to provide free running of the belt. The rolls may be movable so as to provide control of nip sizes (rolls 4, 5) and tension in the belt roll, 6 and/or 7 may be pivotally mounted at the end of weighted arms. Means for mounting the rolls and bearings, drives and heating elements have been omitted from the figure for clarity.

In operation material to be embossed 10, e.g. polyurethane foam backed carpet, is fed into the feed nip 8 as shown by the arrows, with the foam surface on the side arranged to come into contact with the embossing surface 2.

WHAT WE CLAIM IS: —

1. A process for embossing cross-linked flexible polyurethane foam laminated to a carpet which comprises contacting the foam against at least half the circumferential surface of an embossing roll heated at its surface to a temperature of from 120°C to 150°C.

2. A process according to claim 1 in which the foam is maintained against the embossing roll by means of tension in the carpet.

3. A process according to claim 1 or claim 2 in which the embossing roll diameter is 200 to 2000 mm and the contact time with the foam is from fifteen seconds to two minutes.

4. A process according to any one of claims 1 to 3 in which the foam is in contact with from 75% to 90% of the roll circumference.

5. A process according to claim 1 in which the embossing is carried out on apparatus substantially as shown in the accompanying drawing.

6. A foam backed carpet in which the foam backing is produced by a process according to any one of claims 1 to 5.

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1569704 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*